

LYME disease

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SURVEILLANCE SUMMARY



**Bacterial Zoonoses Branch
Division of Vector-Borne
Infectious Diseases
National Center for Infectious Diseases
Centers for Disease Control**

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Two items are presented in this issue of the **Lyme Disease Surveillance Summary**, an interim progress report on CDC funded Cooperative Agreements for research and education on Lyme disease, and the reprint of a recent article published in the **MMWR** on complications of treatment of suspected Lyme disease.

The CDC Cooperative Agreements on Lyme disease are in the final year of a 3-year cycle. It is anticipated that Congress will consider appropriation of funds for a second cycle of Cooperative Agreements to begin in FY 94. If new funding is appropriated, CDC will make efforts to have a Request for Proposal (RFP) announcement published in the **Federal Register** by October 1993 so that awards can be made by April 1, 1994. The timing of the RFP announcement will be published in the **Lyme Disease Surveillance Summary**. CDC is pleased with the progress of Cooperative Agreement projects funded to date and looks forward to a continuation of this program.

The study on adverse consequences of ceftriaxone treatment of suspected Lyme disease patients in New Jersey was initiated as a follow-up of a community-based study of Lyme disease in children conducted by CDC and the New Jersey Department of Health in Monmouth and Ocean Counties in June of 1992. The conclusions of that study highlighted the need to do studies of hospitalized patients, including a study of possible adverse consequences of intravenous antibiotic therapy.

INTERIM PROGRESS REPORT

CDC EXTRAMURAL PROGRAM ON LYME DISEASE Cooperative Agreements and Contracts

Congress appropriated approximately \$3.0 million annually in the period FY 1991-FY 1993 for the Centers for Disease Control and Prevention (CDC) to develop a program on research and education leading to the prevention and control of Lyme disease. Nearly \$2.7 million has been awarded in each of the first 2 years of a 3-year cycle of Cooperative Agreements for extramural projects in the following topic areas: Surveillance and Epidemiologic Studies; Diagnosis and Pathogenesis; Ecology Prevention and Control; and Education. Twenty-six awards were made to state health departments, universities, and private non-profit organizations. Funding was targeted at the most highly endemic regions and to areas with newly emerging disease. In addition to Cooperative Agreements approximately \$0.3 million annually has been awarded for Contracts in the research areas of ecology, diagnosis, and epidemiology. A description of the projects by subject area and measures of progress follow.

COOPERATIVE AGREEMENTS:

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Surveillance and Epidemiologic Studies

Nine projects have been funded that direct all or part of their efforts to surveillance and epidemiologic studies. Six of the recipients in this category are state departments of health: New York, Connecticut, Rhode Island, New Jersey, Michigan, and California. The Medical College of Georgia, the New York Medical College, and the Council of State and Territorial Epidemiologists (CSTE) also received awards. The projects combine efforts to stimulate reporting of cases of Lyme disease, carry out active case detection and validation, and conduct epidemiologic studies to determine personal risk factors for exposure and disease. These studies also address the patterns of emergence of disease into new areas, the magnitude and causes of underreporting and misclassification of cases, and costs of Lyme disease. Highlights of studies to date include:

- Studies by CDC, the New York State Health Department, and the New York Medical College showed that 17% of residents of two highly endemic communities in Westchester County, New York, had serologic or clinical evidence of past infection with *B. burgdorferi*, and, in a prospective study, experienced an attack rate of greater than 3% in one transmission season.
- New York State Health Department found that more than 1,500 patients were hospitalized for Lyme disease in the period 1987-1989 (90% of hospitalizations were for antibiotic therapy), for an average of 6 days, and an average cost of more than \$4,000 per hospital stay. Total estimated direct costs for 1989 hospitalizations were \$4.53 million; this was a considerable increase over the costs of \$1.14 million in 1987 and \$3.78 million in 1988. An underreporting rate of approximately 60% was found for patients hospitalized with confirmed Lyme disease, and 45% underreporting among patients treated at home with intravenous antibiotics. Less than half of the patients hospitalized or treated with home infusion for suspected Lyme disease had documentation of illness meeting Lyme disease surveillance case definition criteria.
- More than 20 home intravenous antibiotic infusion services for Lyme disease operate in Westchester county, and 21% of reported, confirmed Lyme disease patients in Westchester County received home intravenous antibiotic therapy in 1991. During 1991, these treatment costs averaged \$364 per patient per day, \$7,465 per patient per treatment episode, and more than \$3.5 million in total annualized costs.
- An epidemiologic comparison between Lyme disease and babesiosis, a parasitic disease also transmitted by *Ixodes dammini* ticks, was made in New York for the period 1976-1991. Counties with identified endemic Lyme disease increased from 2 to 8 counties during the study period, while babesiosis was not reported outside of Long Island; 26% of babesiosis cases had serologic or clinical evidence of concurrent Lyme disease.
- Active surveillance in Connecticut during 1992 resulted in a 43% increase in reported cases over 1991. The statewide rate of 55 cases per 100,000 in 1992 was the highest in the nation. Active surveillance in a 12-township area surrounding Lyme, Connecticut, resulted in a 61% increase in reported cases in this area in 1992 as compared with 1991, and indicated that the incidence of the disease in this established area of transmission had increased approximately 9-fold since the original studies there 15 years earlier. Other studies document the continued geographic spread in Connecticut. Case-control studies are in progress to identify risk factors for infection and disease in high- and low-endemic regions of the state.

- Michigan State Health Department established a surveillance network and conducted active surveillance to verify transmission in the upper and lower peninsulas of the state. Endemic transmission was identified only in the upper peninsula. Isolation of two strains of *Borrelia burgdorferi* were made from patients residing in Michigan. These are the first such isolations from Michigan.
- Programs of active surveillance for Lyme disease were established in Rhode Island and California. Rhode Island experienced a 92% increase in reported cases between 1991 and 1992, identified the endemic communities in the state, and has shown a strong geographic correlation between a systematically determined entomologic risk and disease incidence. California documented an incidence rate of about 13 per 100,000 in the four most endemic northern California counties, and is conducting case-control studies of risk factors in this population.
- Virginia and North Carolina state health departments initiated active Lyme disease surveillance, and are correlating incidence of Lyme disease cases with the presence of infected deer ticks and animal reservoirs of infection in the two-state region. New areas of enzootic risk have been identified in coastal North Carolina and non-peninsular Virginia.
- Georgia established a research effort to document human infection with *B. burgdorferi* in the state. The spirochete has been cultured in Georgia and Florida for the first time, from ticks and rodents in coastal regions. Approximately 20 patients with suspected, but unproven, Lyme disease have been studied.
- The Council of State and Territorial Epidemiologists (CSTE) completed a 50-state evaluation of Lyme disease surveillance. This national survey provides an additional in-depth analysis of surveillance activities of Minnesota, Connecticut, Rhode Island, and DVVID, CDC, and concludes that the application of the national case definition is workable and has provided useful epidemiologic information.

Improved Diagnosis and Understanding the Pathogenesis

The development of improved diagnostic methods is a high CDC priority. Six university-based projects were funded to more quickly advance this effort. Several projects are exploring the pathogenesis or natural history of Lyme disease to gain knowledge useful to the development of vaccines. Efforts are underway in the following areas:

- Collaborators at the Primate Research Center, Tulane University, infected 14 monkeys by tick bite or needle inoculation. *B. burgdorferi* was cultured from skin lesions and blood, and most animals developed evidence of early localized disease. Most animals also developed evidence of early disseminated disease. Of the 5 animals experimentally infected in 1992, 1 developed obvious clinical arthritis and all 5 had gross and microscopic evidence of arthritis of necropsy. Humoral and cell-mediated immune responses mimic those seen in humans. This is the first primate model of Lyme disease, and provides the best opportunity to date to study the natural history of infection and disease in the laboratory. It is expected to be important in evaluating vaccines and in treatment trials.
- Tufts New England Medical Center has studied the relationship between skin fibroblast cells and *B. burgdorferi*, and has shown that fibroblasts protect the spirochete from the action of antibiotics *in vitro*.
- Yale University, the New York Medical College, and SUNY Stony Brook have produced a number of recombinant proteins and peptides of potential use in an advanced generation of serologic test methods and in vaccine preparations. Researchers at Yale have evaluated over 200 patients with well-defined Lyme disease, and serum samples from these patients are being used in their studies of diagnosis and immunity. Yale has expressed OspA, OspB, flagellin, and the immunodominant flagellin epitope (41-G).

The 41-G antigen appears to be a very good substrate for diagnostic assay. The New York Medical College has produced a number of hybridoma cell lines secreting monoclonal antibody specific for OspA, and is evaluating their use in antigen detection assays.

- The New Jersey School of Medicine and Dentistry is evaluating methods for releasing and identifying antibodies to *B. burgdorferi* that are bound in immune complexes, a phenomenon that occurs in the early stages of disease in some patients.

Ecology Prevention and Control

Primary objectives of the CDC's mission for Lyme disease are stopping its spread into new areas, and bringing about prevention and control of the disease where it is now endemic. Toward this end, CDC has developed a program of laboratory and field research. Nine Cooperative Agreements and two contracts were awarded in this subject area in FY 1991 and FY 1992. Several of these are directed at defining the distribution of the disease and its ecologic characteristics in various geographic settings, especially sites of new and emerging disease. Four of the Cooperative Agreements are targeted at developing practical methods of prevention and control, based on integrated use of chemical tick control, environmental modification, and vertebrate host management. The prevention and control efforts are directed at highly endemic sites in New York and New Jersey. Highlights of FY 1991 efforts include the following:

- Studies in Pennsylvania, Virginia, North Carolina, Georgia and Florida, and in Michigan have newly-identified the occurrence of *B. burgdorferi* in selected foci in these states.
- Cooperative Agreement-supported research in California, North Carolina and Virginia, Georgia and Florida, and contract studies in Pennsylvania have described new ecologic and vertebrate host associations, demonstrating broad and complex adaptations which support the cycle of *B. burgdorferi* in diverse settings.
- The Connecticut Agriculture Research Station is working with the Connecticut State Health Department to correlate intensity of transmission of enzootic Lyme disease with rates of disease in humans, and to map the patterns of disease spread in that state.
- The University of California, Berkeley, has conducted studies quantitating the reservoir competence of vertebrate hosts of *B. burgdorferi*, and compared vector competency of *Ixodes pacificus*, *Ixodes dammini* and other tick vectors using California strains of *B. burgdorferi*. Results indicate that in addition to the wood rat, the California kangaroo rat is a good reservoir host, and that 48 hours or more of *I. pacificus* tick attachment may be needed for efficient transmission of *B. burgdorferi* to occur.
- The Seatuck Foundation is evaluating a multifaceted approach to control Lyme disease on Shelter Island, New York, including burning and clearing of forest understory and brush, killing ticks on deer, and integrated pest management on residential properties. Surveys for the deer tick are being carried out on nearby islands with and without deer populations.
- Studies are being carried out by researchers at the New York Medical College on the feasibility of excluding deer by fencing properties, and the impact of deer control on tick populations. Results suggest that Lyme disease risk could be significantly reduced in residential areas by physically excluding deer. Preliminary studies indicate that medium-sized mammals may be important contributors to populations of immature stages of the deer tick within deer exclosures. The relative importance of chipmunks and mice as reservoirs of infection is being evaluated, and tick control measures that target both hosts are being tried.

- Application of area-wide insecticides has been tested as a method for control of tick populations on residential properties by the New York Medical College in Westchester County, and by the New Jersey Department of Health in Freehold Township. Results have been excellent in both trials with several agents. Single well-timed spring applications have resulted in significant reductions of nymphs for an entire transmission season.
- Cornell University is developing and testing non-toxic alternatives to standard chemical acaricides, such as desiccants, soaps, and biologic agents. Results to date have been promising.

Education of the Public and Health Care Providers

Education is the key to prevention of Lyme disease and its early detection and appropriate treatment. Congress directed that 25% of appropriated funds for Cooperative Agreement research be applied to national education efforts. Nine educational projects were funded by CDC -- awards were made to the New York, Connecticut and New Jersey state health departments, to Pennsylvania State University, and to four private, non-profit organizations (Lyme Borreliosis Foundation, Marshfield Clinic, American Lyme Foundation, and the Arthritis Foundation, Connecticut Chapter). Progress to date includes the following:

- Pennsylvania State University has conducted two national caller-interactive Lyme disease television presentations, dealing with the basic biology, diagnosis, treatment, prevention, and control of Lyme disease. An information service has been developed on the distribution of the tick vector of Lyme disease in Pennsylvania, and a glossary of approximately 1,000 Lyme disease terms has been constructed. Videos and written materials for school children, adults, and medical professionals have been developed and are ready for distribution. Public service announcements on Lyme disease prevention are distributed prior to the Lyme disease transmission season.
- The New York State Health Department is working with Westchester and other county health departments to produce brochures, videos, public service announcements, and has developed a system of user-interactive computer kiosks on Lyme disease which provide evaluations of information transfer to users. Many of these materials are available and in use.
- The Connecticut State Health Department has developed a Lyme disease education module for ninth grade students which include a video, and is completing a similar product for 4-6th grade students. Connecticut is participating with CDC in a national Lyme disease behavioral risk factor survey.
- The Lyme Borreliosis Foundation has developed and is distributing instructional videos aimed at school children, the general public, and workers at risk because of occupational exposures. Videos for school children based on the Muppets have been shown at the V International Conference on Lyme Borreliosis and the annual meeting of the American Public Health Association. These also serve Spanish-speaking and hearing-impaired audiences. A number of public service announcements (PSA's) have been produced and widely shown and aired in the regional media. A wide range of written materials has also been produced and distributed.
- The American Lyme Foundation (New York) has established a telephone information hot-line service and has produced educational videos for elementary and high school students. PSA's have also being produced. Written material is available for the lay public, and an informational brochure for physicians and other health care workers is being produced.

- The Arthritis Foundation (Connecticut Chapter) has produced bilingual posters and brochures, and is completing development of an interactive computer video program to educate elementary school children.
- The Marshfield Clinic (Wisconsin) has produced educational materials for health care providers, a videotaped educational program for school children, brochures for the general public, and a teacher's manual.

CONTRACTS:

Contracts for Isolation of *B. burgdorferi* from Clinical Specimens – The development of suitable diagnostic tests for Lyme disease has been hampered by lack of a "gold standard" reference test, and the inability to make a definitive diagnosis based on clinical examination. To overcome this, DVBID has placed a high priority on attempts to document infection by isolating *B. burgdorferi* from clinical material, and to use serum and other specimens from culture-proven patients for test development and evaluations. The New York Medical College, isolated the organism from 21 of 29 (72%) biopsies of erythema migrans lesions. Similar results (24 of 34, 71%) have been obtained by the Marshfield Clinic, Wisconsin. Serum specimens (often serial), urine specimens, and isolates of *B. burgdorferi* obtained from patients in these series and from other sources form an invaluable reference collection for Lyme disease diagnostic test development and evaluation. Further, the results mark an important step toward establishing cultural isolation as a routine confirmatory procedure in early Lyme disease.

Contracts for Serologic Diagnosis of Lyme Disease – Contracts were awarded to SUNY, Stony Brook, the Robert Wood Johnson Medical Center, the Marshfield Clinic, Tufts, New England Medical Center, and the University of Connecticut, to collect serum samples from well-characterized Lyme disease patients in early and late stages of illness, to submit these samples to CDC for inclusion in a reference serum test panel, and to then test this coded panel with the diagnostic test(s) in use at the respective clinical research center. Serum samples were received by CDC, and testing was completed in 1992 by CDC and the participating centers. This study has documented the reliability and accuracy of the various methods used by CDC and these centers, and the results will be used to establish a standardized and uniform approach to serologic diagnosis of Lyme disease utilizing ELISA and Western blot techniques. A workshop on standardized methodology for participants from public health laboratories from selected endemic states was held at CDC in March 1993.

Contracts for Lyme Disease Ecology – The Maine Medical Center was awarded a contract to study the occurrence of Lyme disease on Monhegan Island in the apparent absence of the usual reservoir host of *B. burgdorferi*, the white-footed mouse. Remarkably, feral *Rattus norvegicus* rats were found to be the reservoir hosts in this island situation, and studies are underway to develop practical methods for their control. Studies of emergence of Lyme disease in an endemic mainland area of Maine are in progress, which will include ecologic and seroepidemiologic evaluations. The University of Indiana, Pennsylvania, was awarded a contract to determine the distribution of *B. burgdorferi* in nature in Pennsylvania. Studies there have shown a statewide distribution of infected mice and ticks, and disclosed efficient transmission cycles occurring in hemlock forests – a previously undescribed enzootic habitat. Hemlock are distributed widely in central and western Pennsylvania, and are common in State and National parks and in camping areas in the state. The unexpected findings of these two contracts highlight the diversity and adaptability of the Lyme disease cycle.

Contracts for Lyme Disease Epidemiology – The State University of New York, Albany, and the University of California, Berkeley, were awarded contracts to examine the association of Lyme disease endemicity and adverse outcomes of pregnancy. Particular attention was directed to possible associations of Lyme disease and congenital malformations. Results of these studies show no spatial association of endemic Lyme disease and adverse outcomes of pregnancy in New York and California, respectively.

Ceftriaxone-Associated Biliary Complications of Treatment of Suspected Disseminated Lyme Disease --New Jersey 1990-1992 (MMWR 42(2):39-42;1993)

Lyme disease (LD) is endemic in Monmouth and Ocean counties, New Jersey (1). In June 1992, CDC and the New Jersey Department of Health (NJDOH) conducted a telephone survey in both counties of 65 schoolchildren who required home instruction because of suspected LD to determine the public health impact of the disease. Most children had received prolonged and repeated courses of oral antimicrobials and/or home intravenous infusion of antimicrobials; 79% had been hospitalized for treatment of suspected LD or management of treatment complications, most notably drug-induced symptoms of gallbladder disease occurring in patients receiving ceftriaxone (Rocephin®), and bloodstream infections associated with intravenous catheters. To determine the characteristics of and treatment complications for patients hospitalized for treatment of LD, a computerized search of hospital discharge data in New Jersey was performed; nearly 30% of all hospitalizations for LD during 1990-1991 were at a regional hospital serving Monmouth and Ocean counties. This report presents findings of an analysis of patients admitted to that hospital for treatment of LD.

A total of 1352 patients was identified as having been discharged from the hospital during January 1, 1990-November 11, 1992, with a primary or secondary diagnosis of LD (International Classification of Diseases, Ninth Revision [ICD-9], code 088.81). To determine risk factors for biliary complications of treatment of suspected LD, a case-control study was conducted. A case was defined as the occurrence of cholecystitis, cholelithiasis, or a cholecystectomy within 90 days of receiving antimicrobial treatment for LD. Cases were identified through cross-referencing the 1352 patients with codes for biliary disease (ICD-9 codes 574.0-576.9) or cholecystectomy (ICD-9 codes 51.22-51.23). Controls were selected randomly from hospitalized patients who had received antimicrobial treatment for LD but who did not develop evidence of gallbladder disease.

Twenty-five (2% of the cohort) case-patients were identified, with a median age of 12.0 years (range: 3-40 years); 84% were female. All had received intravenous ceftriaxone within 90 days preceding the onset of biliary symptoms. Daily dosage of ceftriaxone at the time of onset of biliary symptoms averaged 57 mg/kg (range: 27-96 mg/kg) in 17 case-patients for whom information was available in inpatient medical records. The median duration of treatment with ceftriaxone in the treatment course immediately preceding the onset of biliary symptoms was 28 days (range: 4-170 days) in 21 case-patients for whom information was available in medical records. Of the 25 patients, 14 (56%) underwent laparoscopic cholecystectomy; 12 of these 14 patients were less than or equal to 18 years of age. In 11 of these 14 surgical cases, pathology reports described gallbladder calculi (often multiple) of 2-10 mm in diameter and in some cases soft and greenish in color. In two surgical cases, the gallbladder was acalculous; in one, it contained fine gravel.

Fifteen (58%) of 26 controls were documented to have received at least one course of intravenous ceftriaxone for treatment of LD. When case-patients were compared with controls, risk factors for biliary disease included being aged less than or equal to 18 years (odds ratio [OR]=8.4; 95% confidence interval [CI]=1.4-64.5), being female (OR=4.5; 95% CI=1.0-21.0), or having a history of treatment with intravenous ceftriaxone (OR undefined; p less than 0.001, Fisher's exact test).

Of those for whom data were available in their inpatient records, one of 24 case-patients and one of 21 controls had a documented history of physician-observed erythema migrans (EM), and four of 24 case-patients and two of 21 controls had documented objective evidence of disseminated LD (i.e., secondary EM, arthritis, carditis, meningitis, neuritis, encephalomyelitis, or encephalopathy) (2,3). Laboratory reports of results of serologic tests for antibody to *Borrelia burgdorferi* were contained in the medical records of 22 (88%) case-patients and 18 (69%) controls. Of the 51 patients, six (12%) had only positive test results documented; 26 (51%) had only negative test results documented; eight (16%) had both positive and negative test results documented; and 11 (22%) had no results documented. Case-patients and controls had each received a median of three courses of antimicrobials (range: 1-7) for suspected LD.

A review of records of the original cohort also revealed 22 patients with intravenous catheter-associated bloodstream infections; 29 separate episodes of bloodstream infection occurred in these patients. The median duration of catheterization in these patients (measured from insertion to diagnosis of bloodstream infection) was 152.5 days (range: 16-764 days). The blood isolates from these patients included a variety of gram-positive and gram-negative bacteria. Studies are in progress to identify risk factors for such infections.

Editorial Note: During 1982-1991, more than 40,000 cases of LD were reported by state health departments to CDC, 92% of which were reported by states in northeastern, north central, and Pacific coast areas in which LD is known to be endemic (4). Early localized LD is characterized by an EM lesion and a variety of nonspecific symptoms and signs (2). Disseminated LD usually is preceded by untreated or inadequately treated EM by weeks to years and characterized by major manifestations such as arthritis, neuritis, meningitis, encephalomyelitis, encephalopathy, or carditis (2). Most patients infected with *B. burgdorferi* develop detectable antibody within a few weeks after infection (although early treatment may delay or prevent further development of antibody) and most patients with late LD are seropositive (2,3,5). However, not all LD patients develop a recognized EM, signs and symptoms of disseminated LD are protean and can lead to diagnostic confusion, and problems exist with the reliability and accuracy of serologic tests (2,5,6). Most patients treated for local or disseminated LD respond to standard courses of oral or parenteral antimicrobials, including ceftriaxone (5).

This report highlights several important issues related to the diagnosis and management of suspected LD. Most patients hospitalized for suspected LD in this study lacked documented objective manifestations of disseminated LD or seropositivity to *B. burgdorferi*. The demographic profile of these patients, mostly preadolescent and adolescent females, differs from that of LD patients reported nationally during the study period (4). The repeated and often prolonged courses of antimicrobials prescribed in these cases suggest that antimicrobial therapy did not achieve satisfactory remission of symptoms and was associated with biliary complications resulting in cholecystectomy in some patients.

Ceftriaxone is recommended in the literature for treatment of disseminated LD (7), although it has not been approved for this use by the Food and Drug Administration. Ceftriaxone is a semisynthetic third-generation cephalosporin that is excreted primarily in urine but also in bile (7). Biliary precipitation of ceftriaxone as a calcium salt is a known cause of sporadic cases of pseudocholelithiasis (sludging), frank cholelithiasis, biliary colic, and cholecystitis (8,9). Upper abdominal ultrasonography should be considered for patients who develop biliary colic while receiving ceftriaxone. Biliary precipitates of ceftriaxone may be evident sonographically after as few as 4 days of treatment, are possibly dose-related, and are often asymptomatic (7-9). Spontaneous disappearance of these precipitates within 2-63 days following the last dose of ceftriaxone has been documented; discontinuation of ceftriaxone and nonsurgical management of this complication has been recommended (8,9). Although bloodstream infection is a well recognized complication of indwelling central catheters (10), it has not been previously reported in relation to LD treatment.

Physicians should be familiar with the diagnosis and management of LD and its treatment complications (2,5,6). Hospitals and clinics, particularly in areas with endemic LD, should follow recommendations that address these issues, as well as the use and interpretation of laboratory diagnostic tests (6). In-home intravenous therapy programs as well as health-care facilities should be alert to potential complications associated with LD treatment. Because new information on LD is rapidly developing, ongoing medical-education programs on this disease are needed. CDC is working with professional societies and others to develop guidelines on diagnosis and management and to provide training materials. LD information can be obtained from CDC's Voice Information System, telephone (404) 332-4555; from CDC's Bacterial Zoonoses Branch, Division of Vector-Borne Infectious Diseases, National Center for Infectious Diseases, telephone (303) 221-6453; or from the National Institutes of Health, National Institute of Allergy and Infectious Diseases, Office of Communications, telephone (301) 496-5717.

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REPORTING OF LYME DISEASE CASES IN 1993 BY NETSS

The numbers of Lyme disease cases reported through NETSS in the period January through April 3, 1993 are shown in Figure 1. Of the total 660 cases reported through Week 13, 539 (82%) were reported from the mid-Atlantic and New England regions. Upstate New York and Pennsylvania have reported 435 (66%) of cases during this early 1993 period.

Figure 1.
Reported Lyme Disease Cases by Week of Report, U.S., 1993

